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D-2 MA DRILL KIT MANUAL

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OPERATING MANUAL

FOR THE

TYPE D-2 DRILLING KIT

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OPERATING MANUAL FOR THE TYPE D-2 DRILLING KIT

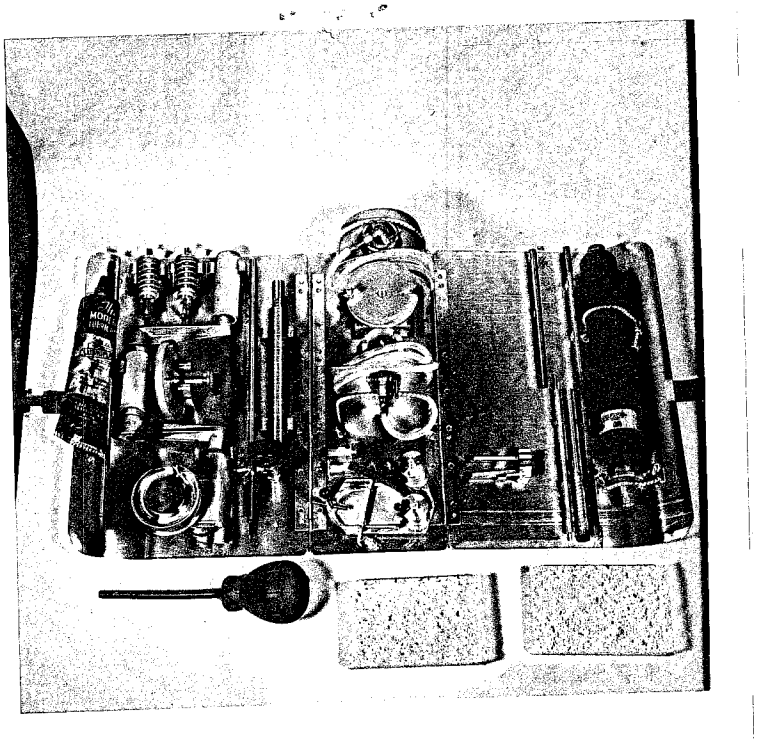
1. DESCRIPTION

a. General

The type D-2 drilling kit is a manual powered (brace type) unit which should prove useful where no electric power is available. It is provided with impregnated diamond core drill bits (water flushed) and carbide-tipped drill bits (water or air flushed). The nominal hole diameter is 3/8 inch, with the smaller of the two bit sizes provided. Two extension shafts (36 centimeters each) are provided to extend the 20 centimeter drills for a total length of 92 centimeters (approximately 36 inches). This maximum depth is reduced to approximately 84 centimeters (or 33 inches) when the winch accessory is used. The larger drill bit provided is nominally one inch diameter and 20 centimeters in length. The extensions do not work with the large drill but special extensions could be made on special request. The diamond drill bits allow penetration of any masonary materials including granite but the drilling rate naturally varies greatly with the hardness of the material. The carbide-tipped bit can be used in soft and medium hard masonary materials and will also drill (although inefficiently) wood and steel. Representative drilling rates for the diamond drill bits are: brick - 2 centimeters/minute; concrete and marble - 0.5 centimeters/minute; and granite - 0.2 centimeters/minute. It must be recognized that this is inherently a slow method of drilling and that the actual drilling time will be only part of the total time and allowances are necessary for setup, core removal and cleaning, addition of extensions, etc.

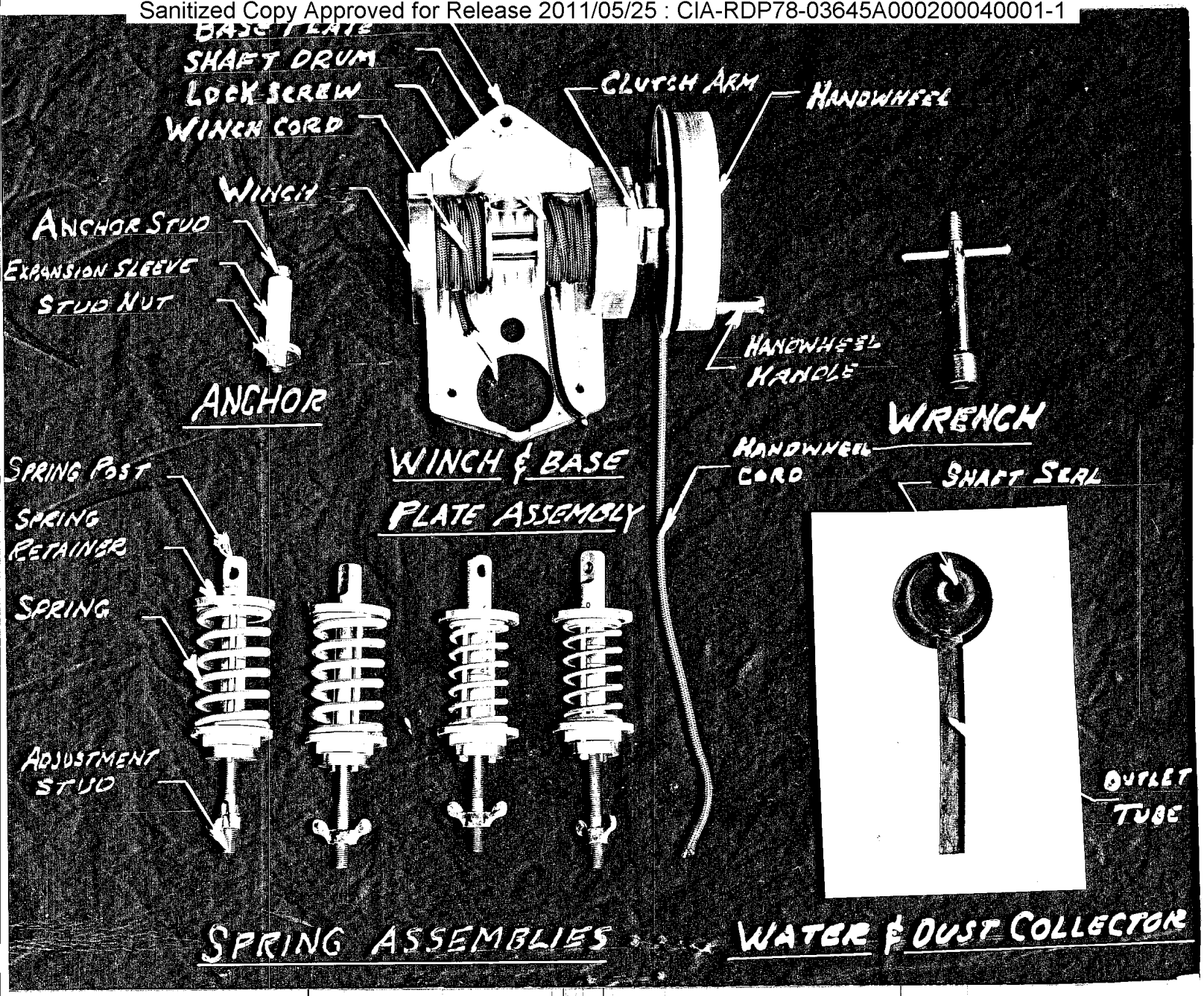
2.54 cms = 1 inch

The various components of the kit are fastened to a folding frame which allows the kit to be carried conveniently in an outer case (not provided). The complete unit weighs approximately 23 pounds.



b. Parts List

1. Hand brace
2. Brace back-up plate
3. Winch with lock screw
4. Wall plate with 2 light springs, water collector and wrench.
5. Heavy springs (two)
6. Expanding plug (short)
7. Expanding plug (long)
8. Water tank with two lengths of tubing
9. CO_2 cylinder
10. Impregnated diamond core drill, one inch diameter
11. Impregnated diamond core drill, 3/8 inch diameter (two)
12. Carbide drill, 3/8 inch diameter
13. Core breaker
14. Core extractor
15. Clean out rod
16. Drill extensions (two)
17. Strap wrenches (two)
18. Sharpening stone (silicone carbide)
19. Grease tube
20. Syringe
21. Sponges (two)
22. Case



c. Hand Brace

The hand brace is fundamentally very simple and rugged (see assembly drawing) but has a number of special features. The bearings are made of a particular plastic for smoothness and low friction. A removable Back-up Plate is provided and the need for water flushing with hollow drills requires a rotating water seal. A water valve and pressure gauge are provided for controlling water flow.

An accessory winch can be mounted on the front of the brace to reduce the effort required for drilling.

d. Winch and Wall Plate

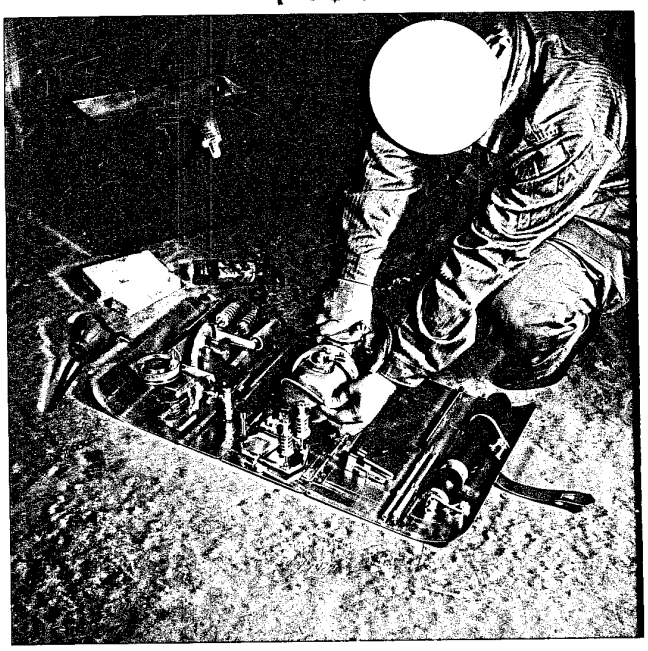
Since this drilling method requires a continuous force on the bit for long periods of time, it is, in some cases, almost impossible to do the job by simply leaning on the brace. For those cases, a winch has been provided to force the drill into the material and save the strength of the operator for turning the brace. The winch is normally mounted on the front of the hand brace (but may be removed easily for greater convenience where it is not required) and the winch cables in turn are fastened by loading springs to a wall plate. The wall plate is held firmly in place by an expanding anchor stud in a short hole. This first hole must be produced with manual pressure on the drill. Calibrated springs are provided for two major purposes. First to apply a continuous force to the drill with only intermittent cranking of the winch and second to allow the operator to set the load within recommended limits. The spring attachment also provides for a method of equalizing the forces in the cables. A water collector and seal is also

provided with the water plate to return used water to the tank.

e. Water and CO_2 Tanks

A fairly complicated water recirculating system (see assembly drawing) is provided instead of a simple pressurized water tank because the slow drilling rate of this unit results in a large amount of water required over the period of time necessary for deep drilling. The reuse of the water thus alleviates the water supply problem. (Of course, there are cases where there are voids in the material, resulting in no water return. Additional water must then be provided.) The water tank has two sections, the reservoir side and pressure side. Pressure is maintained on the pressure side by a cushion of air over the water. The air is not pumped in, but is trapped by pumping water into the sealed tank. In this way the pressure is maintained as the water flows out and more is pumped into the pressure tank from the reservoir. Certain precautions (see operating instructions) are necessary with this system to maintain the correct amount of air cushion under abnormal conditions. The connecting tubing is arranged to remain fastened to the tank in disassembly of the kit and valves are provided to seal both sides of the tank with the tubing open at one end. A thumb screw hold-down is also provided on the foot pump plate. When tightened down, a seal is made in the pump cylinder to prevent leakage in transit. The syringe is provided as an aid to filling the tank.

The CO_2 tank is provided for flushing the carbide-tipped bit where water cannot be used. It may be refilled with air if CO_2 is not available.



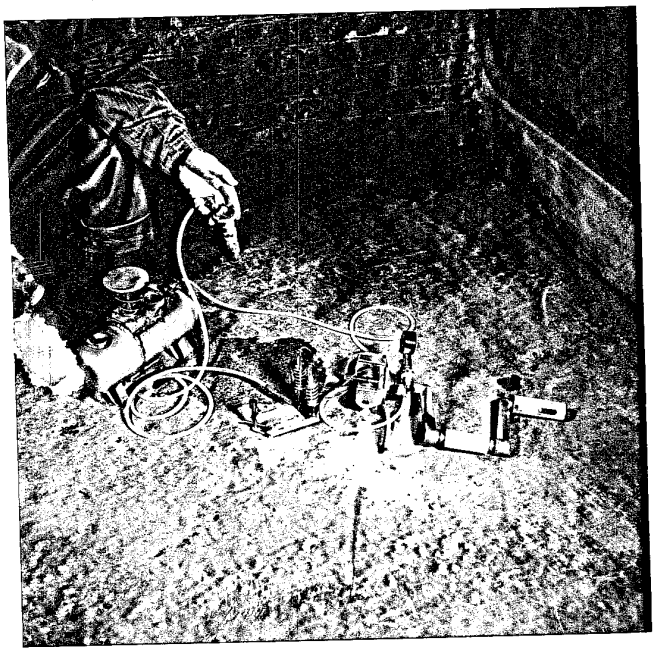
2. OPERATING INSTRUCTIONS

a. Fastening of Parts in the Kit

All the parts except for four (grease, syringe, two sponges) are fastened down in the kit to avoid rattle and to hold the parts in place. Since there is a considerable amount of equipment in a small space, it is essential to put each piece in its proper place when repacking or the kit will not fold up. The operator may find it helpful to paint outlines of the equipment pieces on the sides of the kit to aid in relocating the parts. If it is expected that the kit might have to be packed up in a hurry, a canvas sachel would be a recommended accessory to allow quick temporary packing of the gear. The operator should note the method of retaining the cleanout rod in the clips under the core breaker.

b. Tubing Connections

The accompanying pictures are almost self-explanatory but it should be noted that there is a quick disconnect fitting on the tubing connecting the brace to the pressure side of the tank (identified by the pressure relief valve). To release or connect this fitting the outer sleeve must be slid back against the spring. This relapses the locking fingers and thus allows disconnection. The tubing clamps used at three points are not absolutely necessary but are provided as a safety measure. If the tubing becomes enlarged at the end and loses its grip, it can be fixed by cutting off one inch of tubing and remaking the connection.



e. Filling and Pumping Procedure for Water Tank (see assembly drawing)

Since the water is pressurized by a cushion of trapped air (see Description) it is necessary to observe certain precautions in filling and using the tank, particularly if the safety valve has opened. Since the pressure gauge at the drill brace is the only pressure indication, the pressure tank hose should be coupled to the brace. The valve at the brace should be closed and the tank valve opened (handle in vertical position). To fill, the supply end of the tank is first filled with water and this water is pumped into the pressure end, resulting in a pressure of about 20 psi. The supply end should then be refilled. Four to five piston strokes should then bring the pressure up to about 45 psi. Some more water may then be added to the reservoir but do not fill it more than halfway at this point or there will not be enough room for return water and it will overflow. The operating pressure range should be approximately 45 to 25 psi. When using the pressure tank, the filler cap should be unscrewed one or two turns for the purpose of venting the supply tank. If this is not done, a partial vacuum will be created in the supply tank which will prevent the piston from returning from its down stroke. The pressure safety valve is set for about 55 psi. In the event that this pressure is exceeded, the pressure will be released and the air bank will be lost. If this should occur, the air must be replaced. This can be accomplished as follows:

(a) Reseat safety valve by depressing the safety valve spring thus reseating safety valve piston

(b) Empty water in pressure can by unscrewing safety valve assembly. Replace safety valve and follow filling instructions.

(c) If desired, this can also be accomplished by emptying the supply can and pumping up to pressure. This will allow the piston to pump air only into the pressure can, thus restoring the air bank. When this has been done, the supply can should then be refilled.

As with the brace, cleaning the tank after use is important because of the abrasive nature of masonry dust. The collector tube has been provided so that small particles can not prevent the check valves from operating properly. Cleaning is easily accomplished by dumping both supply and pressure cans and then flushing with clean water. Clean water should also be pumped through the system to flush the valves and cylinder. The collector tube should be unscrewed and cleaned separately. Note that the collector tube normally has water trapped in it. Therefore when it is removed from the tank to add water, it should not be tipped over on a surface which would be harmed by the water.

d. Mounting Drill Bit on the Brace and Use of Extensions

It is recommended that grease be applied to the threads and o-ring gasket before connecting the bit to the brace or adding extensions. The threads should also be checked for any accumulation of dirt and wiped off or blown clean before connecting to avoid unnecessary wear and binding.

When the drill bit is in place with both extensions, the whole assembly must be handled with extreme care to avoid bending or breaking the long slender shaft by hitting it against some other object. The same precaution applies even without the extensions because the tip of the diamond drill bit is very fragile and is apt to fracture if knocked against a hard surface with the weight of the brace behind it.

Strap wrenches (see 2.h.) are provided to loosen the threaded connections if they bind.

c. Starting the Drills

Since the drill bits supplied with the kit are of the coring type and have no center, a special technique has to be used to start the drill and prevent it from "walking around" on the surface. This problem is particularly difficult on hard materials, such as granite. A successful technique is as follows:

(1) With drill bit assembled on brace and water tank filled, up to pressure (45 psi) and tubing connections made, carefully adjust the water control valve (next to the pressure gauge) to produce a trickle of water out the end of the drill.

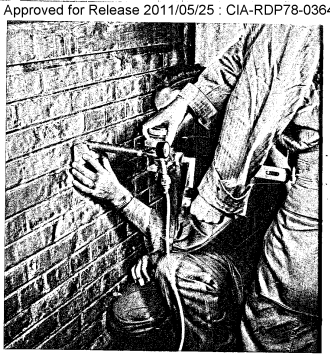
(2) Push the drill against the surface with about 5 pounds of force (not critical) at the spot where a hole is desired.

(3) Move the brace arm back and forth through a small arc (about 1/16 of a revolution) and try to keep the tip of the drill from moving about on the surface. This reciprocating action has the effect of wearing a circular groove in the material, which keeps the drill from wandering.

(4) When a slight groove is established, the reciprocating action may be stopped and the drilling may proceed by turning the brace arm in the normal manner.

In hard materials the drill bit has a tendency to unscrew at the coupling on the reverse portion of the reciprocating action. This can be prevented by tightening the drill with one of the steep wrenches provided.

The large drill presents somewhat greater difficulty in starting and requires more patience at from the operator. In case of serious trouble with drill wander on starting, an alternate procedure can be used if a second operator is available. The second operator holds a guide block of wood (with a V-notch cut into one side) against the surface. The tip of the drill is held in line by the V-notch and the brace is turned in the normal way to start the hole.



f. General Tips on Drilling

(1) One of the first things noticed in using this unit is that the water seal and winch assembly has a tendency to twist around the brace, fouling up the winch cables and water tubing. Where convenient, this is best prevented by holding onto the pressure gauge and valve assembly, with one hand. The water flow control valve is easy to manipulate from this position. If both hands are tied up elsewhere, another method is to place one's foot over the pressure water tubing in such a way as to prevent the twisting of the seal assembly. Another method would be to fasten a long, slender rod (not provided) into the threaded hole on the winch frame and have this rod strike the floor or some protruding object to prevent rotation of the seal.

(2) The operator should become acquainted with the "feeling sensations" which signal various drilling conditions. In normal drilling there is a very, very slight vibration caused by the cutting action. When water flow stops for any reason, the cutting edges clog up after a few revolutions and this very slight vibration ceases. The motion thus becomes very smooth after clogging and this sympton should be recognized and the drilling stopped and the trouble determined. If the drilling is continued without water the smooth turning becomes increasingly difficult until it binds up completely.

The symptoms are approximately the same whether the water stoppage is caused by lack of water pressure, too large a winch force, or core clogging.

(3) An indication of water flow can be observed from the pressure gauge needle. Since water flow is extremely important, it should be

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(8) With the slender drill shafts in a hole the brace must always be held in alignment with the hole to prevent bending the bit or extensions. Therefore the brace should always be supported by hand and its weight should not be allowed to hang on the slender shafts.

(9) The impregnated diamond core drill bit may lose some of its cutting ability if it becomes glazed or dull on the forward edge. They may be sharpened by exposing new diamonds. This is accomplished by drilling directly into the silicon carbide stone which is supplied for this purpose. Water should be used for this operation in the same manner as in conventional drilling. This same stone may be used to sharpen the inserted tips of carbide drills.

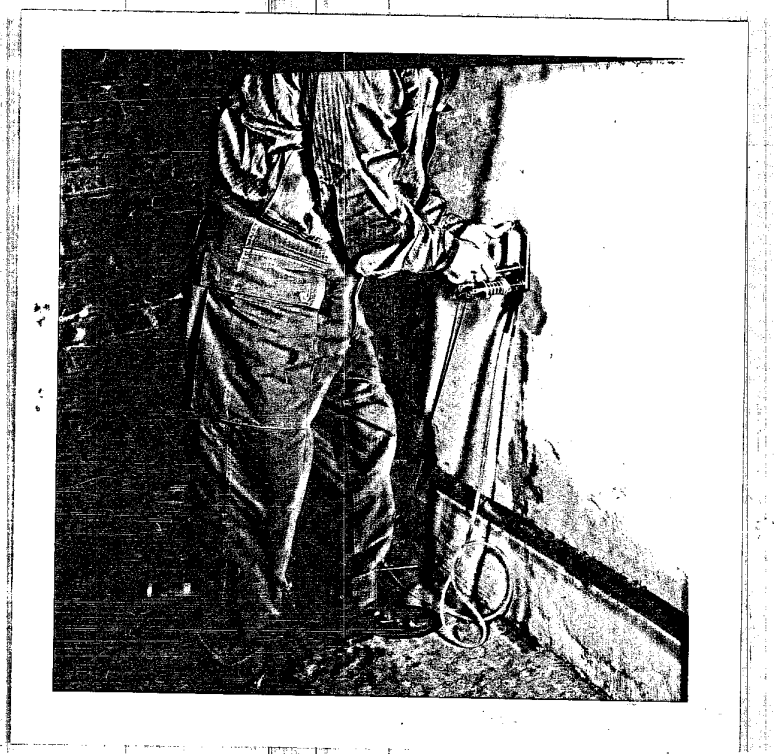
6. Set-up and Use of Winch and Water Collector

The winch is not generally necessary for short holes or in soft materials but will probably be welcomed in most other cases.

A water-and-dust collector is included in the kit, but the use of this device with the winch device is optional. The water-and-dust collector is a rubber component that may be used to receive the water or dust from the drilling operation and then (in the case of water) permit these drilling wastes to be drained back into the reservoir.

When the water-and-dust collector is to be used, the unit should first be inserted through the large (1-7/32-inch diameter) hole in the base plate. The large flange of the water-and-dust collector should be seated against the completely flat side (i.e., the back) of the base plate. The water-and-dust collector and the base plate are then ready to be mounted to the surface of the material to be drilled.

A hole approximately 3 centimeters deep should be drilled in the material to permit mounting the base plate by means of the anchor. With the base plate held firmly against the surface of the material, the anchor should be inserted through the small hole in the base plate and into the previously drilled hole in the material, as illustrated. The anchor should be tightened in position by turning the stud nut clockwise with the wrench through 5 or more turns. During the tightening operation, the anchor stud may continue to turn without the anchor tightening in the hole. In this case, the anchor should be removed from the hole and the end of the anchor expansion sleeve expanded to provide a slight interference fit between the anchor and the hole when the anchor is re-inserted in the hole. This should be done by lightly



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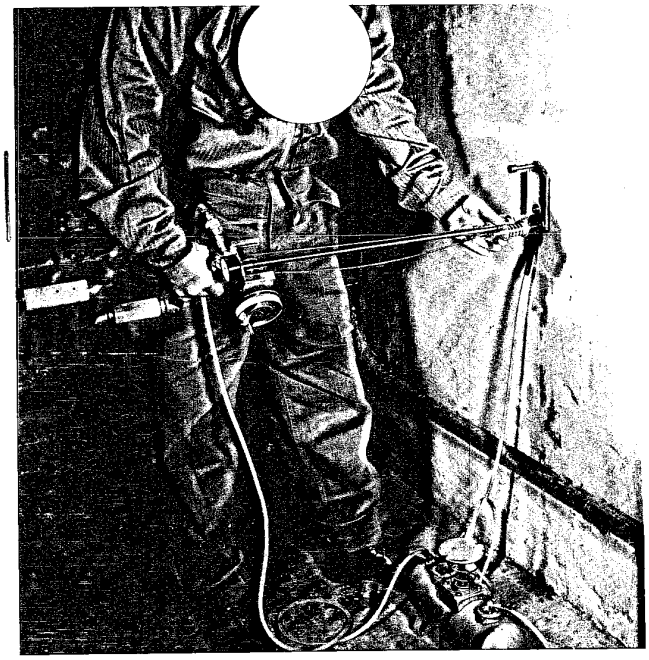
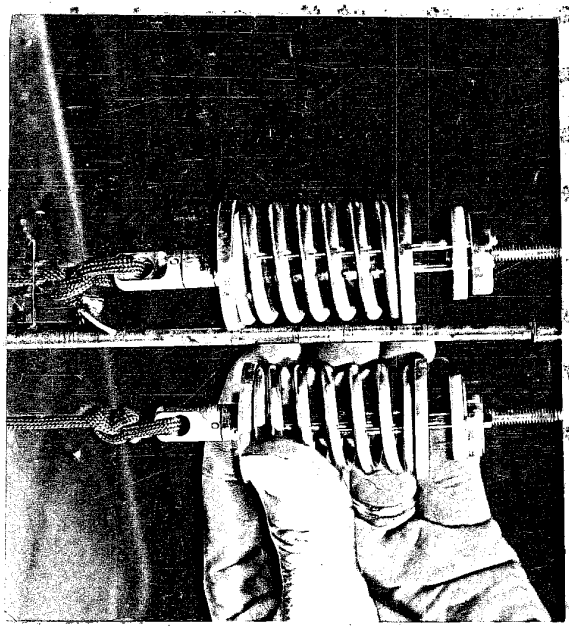
pushing the tapered end of the anchor stud into the anchor expansion sleeve and then tightening up the stud nut. The anchor should then be inserted into the hole and tightened as previously described.

Note 1. The security of the base-plate mounting should be checked by pulling on the base plate by hand; also, the threaded end of the wrench can be screwed into the base plate and the wrench used as a handle in pulling on the base plate. If the anchor cannot be pulled from the material (to be drilled) in this manner, the device is sufficiently anchored for drilling.

Note 2. When the water-and-dust collector is used and leakage occurs at the face seal, additional pressure can be applied to the face seal at the material (to be drilled) by screwing the wrench into the base plate. As the end of the wrench contacts the material to be drilled, the base plate is pivoted at the anchor and the water-and dust collector face seal is compressed between the base plate and the material.

To attach the cable to the springs, the winch cord should be unwound from the winch drums by grasping and pulling on the ends of the cord with one hand while the other hand is used to release the clutch by rotating the clutch arm in the clockwise direction. (The direction of

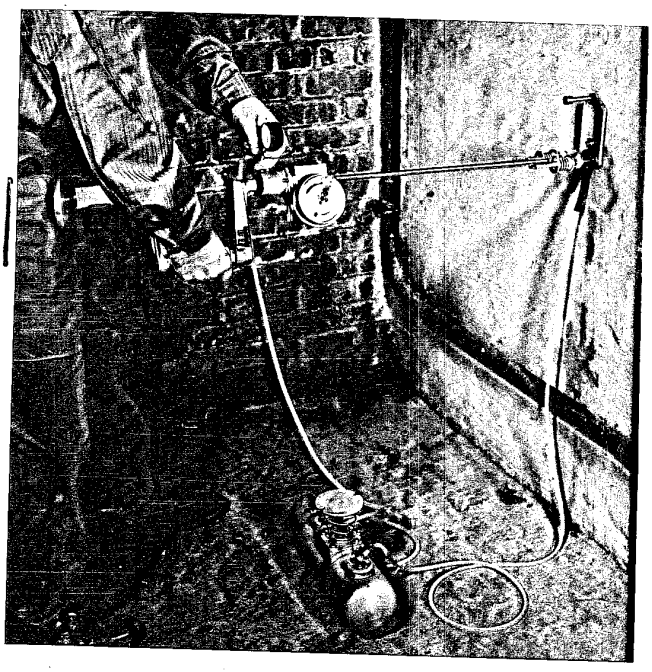




rotation of the handwheel and clutch arm is specified on the basis of the operator facing the handwheel side of the tensioning device.) The ends of the winch cord should then be tied to the previously installed pair of spring assemblies and the cord length equalized by sliding the cord through the holes in the shaft drums. With the drilling unit in the operating position, the excess cord should be wound onto the shaft drums by turning the handwheel in the clockwise direction. The handwheel can be turned by grasping the knurled portion of the handwheel or the handwheel handle.

The drill, in position in the brace unit, should be inserted through the large hole in the base plate; or, when the water-and-dust collector is used, the drill shank should be lubricated and then inserted through the hole in the water-and-dust collector. The drilling should be started (technique described elsewhere) with force supplied by the operator. Then, the handwheel should be turned in the clockwise direction until the desired axial load is applied to the drilling unit. The amount of load that is applied by the force of the springs in the spring assemblies is indicated by the position of the spring retainer along the scale, in pounds, marked on the spring post. If the forces in the two springs are not equal when the springs are compressed, one of the spring assemblies should be threaded along the adjustment stud until the spring forces have been equalized.

Note 1. The springs of the spring assemblies should not be fully compressed; otherwise, an excessive load may be applied to the winch and the anchor may be pulled from the material being drilled.



Note 2. The spring load on the drilling unit can be returned to zero at any time by releasing the clutch, i.e., by rotating the clutch arm in a clockwise direction.

With the 3/8 inch diameter diamond core drill bit, the load should be approximately as follows:

brick - 20 pounds total (10 pounds in each spring)

concrete - 40 pounds total

marble - 45 pounds total

granite - 55 pounds total

These load figures are given as examples only. The optimum load is best determined under the individual operating conditions. The calibrated springs allow operation at practically constant force so that accurate conclusions about the best load can be made without complete reliance upon "operator feel". (However, "operator feel" is still important in using these drills.)

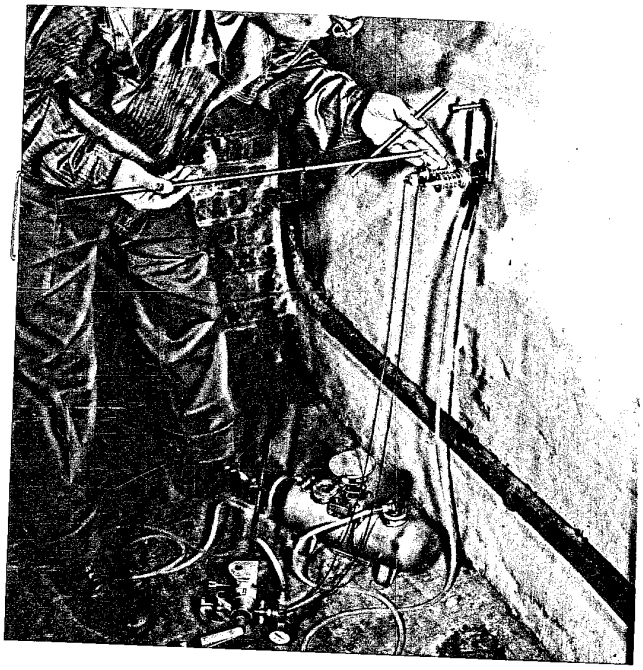
At higher loads there is a tendency to cut down the flow of flushing water at the cutting surface, which results in clogging of the individual cutting particles and a loss of drilling rate. This tendency is greater with the softer materials, so lighter loads are recommended. If trouble is experienced with the drill clogging frequently, either too high a load or too little water pressure might be the cause.

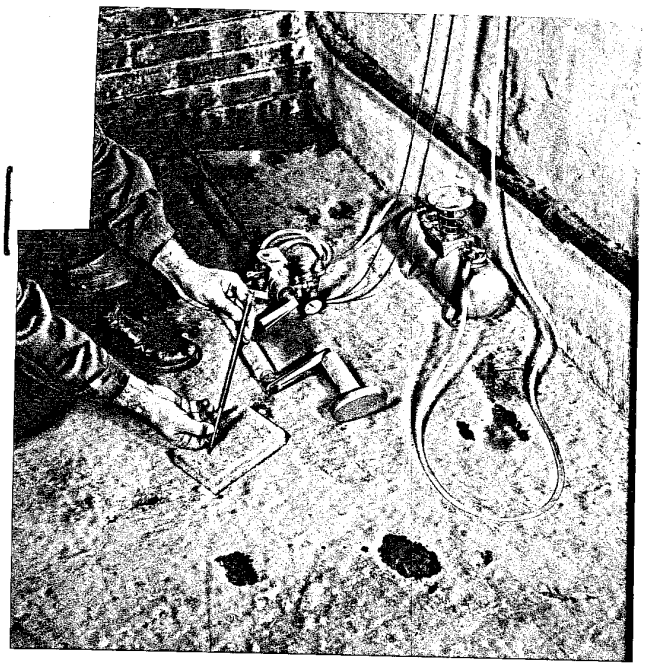
With the larger diamond core drill, somewhat higher loads may be used but the limiting factor is often the torque that can comfortably be applied by the operator.

See "Use of C rbide Bit" for appropriate loads when using this type of drill bit.

h. Strap Wrenches for Drill Shafts

Ordinarily the drills and extensions can be connected and disconnected by hand, but occasionally they will bind and require a wrench. Strap-type wrenches must be used because no flats can be made on the hollow shafts. The loop of abrasive cloth is slipped over the end of the shaft and positioned close to the joint. (The hollow shafts have very thin walls in the center section and could collapse if too much force was applied to the wrench. Therefore, keep the wrench near the joint where there is greater wall thickness.) The wrench is made to grip by forcing the loop (by thumb pressure) to the side of the wrench handle as shown. Two wrenches must be used in opposing direction to separate the extensions. The abrasive cloth material in the wrench will gradually stretch with use, making it difficult to grip the shaft. It should then be tightened by loosening the screws and adjusting the cloth with respect to the clamp. The cloth may also be turned over to expose new abrasive surface or may be replaced with 320 grit waterproof emery cloth.

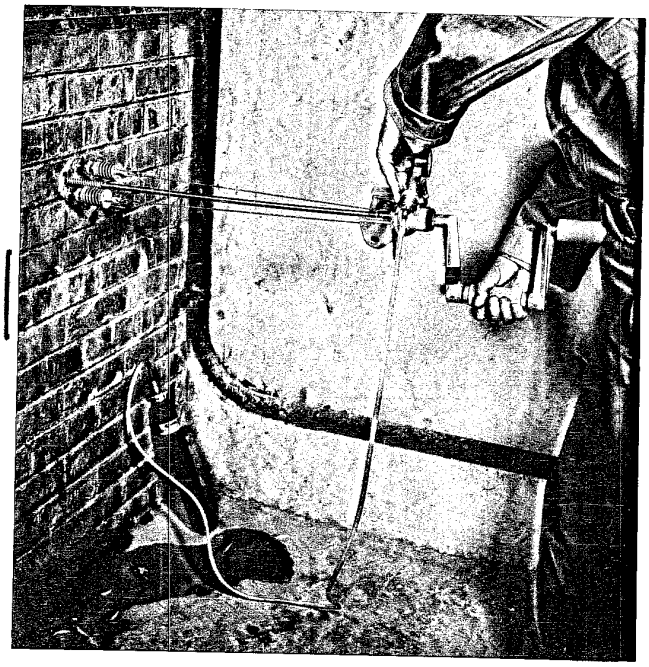




1. Removing Cores and Use of Core Breaker and Core Extractor

The condition of the cores that result from the use of the core drills varies greatly according to the material. In crumbly material the core invariably breaks up into small pieces which remain inside the drill bit. If many small pieces accumulate inside the drill, there is a tendency to clog up due to the water pressure in the drill. Therfore the bit should be removed after about 3 centimeters of drilling and the particles flushed out of the bit. If the particles are allowed to clog up, it is then necessary to remove the bit from the brace or extension connection and use the cleanout rod to force the particles out. In harder and stronger material, the core usually takes the form of small cylinders in lengths from one half centimeter to 3 centimeters. The same precautions about clogging apply in the harder materials but generally more drilling can be done between cleaning operations. In the strongest materials, the core is very likely to remain fastened to the end of the hole. It can be broken off by use of the core breaker tool which has a wedging action and breaks off the core to allow its removal. When drilling in material which causes fastened cores, the core should be broken off every 3 centimeters.

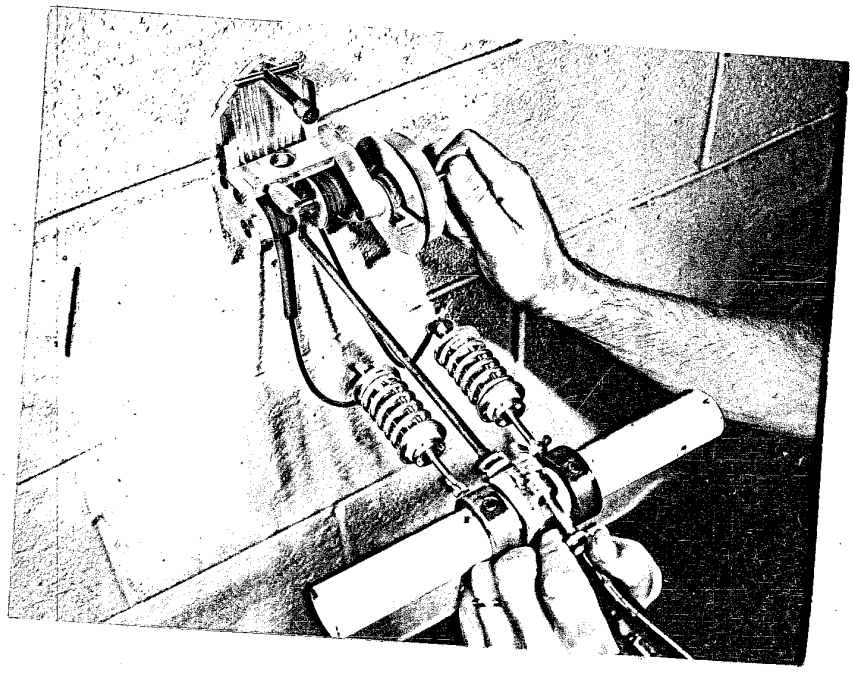
Cores in deep holes can be removed by use of the core extractor which fits on the extension shafts and has spring fingers on the end to grip the core.

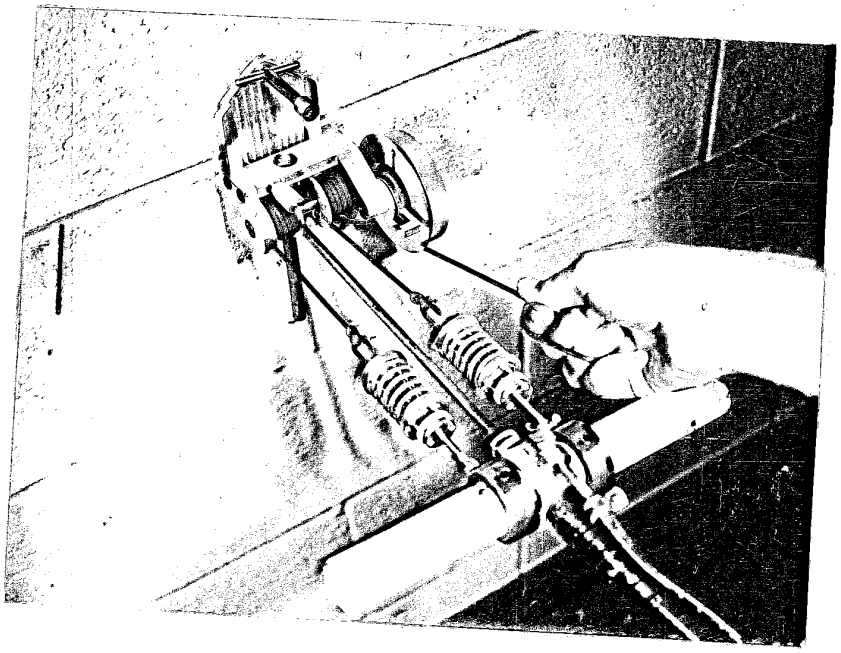


k. Use of Air Flushing with Carbide Drill

To hook up the CO_2 bottle for air flushing, the pressure tubing connection at the tank must be disassembled. The same tube is then used to connect the CO_2 bottle to the brace. CAUTION: The flow of gas must be controlled by the valve on the bottle. The valve by the pressure gauge on the brace must be left open. Otherwise the plastic tubing will be exposed to the high pressure in the bottle and will blow off. Also, while using air flushing, the pressure gauge must be watched carefully and clogging of the flushing hole in the drill must be avoided to prevent high pressure building up. The pressure gauge will be damaged if these precautions are not observed.

The flow of air is controlled by the circular valve handle on the air bottle and should be adjusted to produce just enough flow to give a slight audible hiss. At this rate of flow a full bottle should give several hours of drilling.





J. Use of Carbide-Tipped Drill Bit

Starting the bit with three carbide tips presents difficulties similar to those with the diamond core drill because there is again no center to the bit to keep it from wandering. The same techniques apply except that the use of a wooden guide block is the preferable method.

A most important point to observe with the carbide tipped bit is that a heavy load must be kept on the bit during drilling or the tip will wear without producing significant results. The winch provided is ideal for this purpose and the heavy springs should be used on the wall plate with the carbide bits and the load should be maintained between 75-100 pounds.

It is also very important to use bits that are sharp because a worn edge on the bit causes very inefficient drilling. Unfortunately, it requires a special grinding wheel (silicone carbide) and a jig to hold the bit properly in order to get the best results. Therefore, the facilities of a machine shop are generally needed. The appropriate grinding angles can be judged from the original shape.

The carbide-tipped bit can be used with either water or air flushing. The water flushing operation is the same as that for the diamond core bit and the setup for air is covered in another section.

If necessary, the carbide tipped bit can be used in wood or steel but it is not very efficient for the purpose.

1. Use of the Winch with Separate Power Drills

The winch assembly provided in this kit was designed with a second application in mind. That is to assist the operator in using ordinary, commercial heavy duty electric power drills. These are normally used with carbide tipped drill bits of large diameter and require very large forces for effective drilling.

For use of the winch for this purpose, it is disassembled from the brace and mounted on the wall plate by sliding it over the edges of the wall plate, as illustrated. The pulling direction is reversed from the other applicator since the winch is at the surface and the springs are fastened to the drill frame. An adaptor may be made up to fit the threaded spring mount onto the drill or a cable may be simply tied to the drill housing and to the wing nuts on the springs. The heavy springs should be used and in many cases the winch will provide enough force to stall the drill.

The use of a handwheel cord is illustrated and this cord is wrapped in the slot of the handwheel and allows the wheel to be rotated from a distance of several feet.

3. MAINTENANCE

a. Brace

(1) Cleaning and flushing the rotating water seal will greatly extend the life of the bearings and quad type rubber sealing o-rings.

(2) With two exceptions as follows, the disassembly of the brace is obvious by referring to assembly drawing No. 314-201.

(a) If it is necessary for any reason to remove brace shaft (314-458) from the brace handle (314-315), the screw holding detent spring assembly (314-313) should be loosened to prevent interference between detent and thrust collar (314-456).

(b) If it is necessary to remove crank handle (314-316), one of the two taper pins, which secure the cast brace arms to the crank shaft, must be removed by means of a hammer and punch. Exercise care when removing pin so that the alignment of the brace arms will not be distrubed. Use a punch no larger than 5/32" diameter.

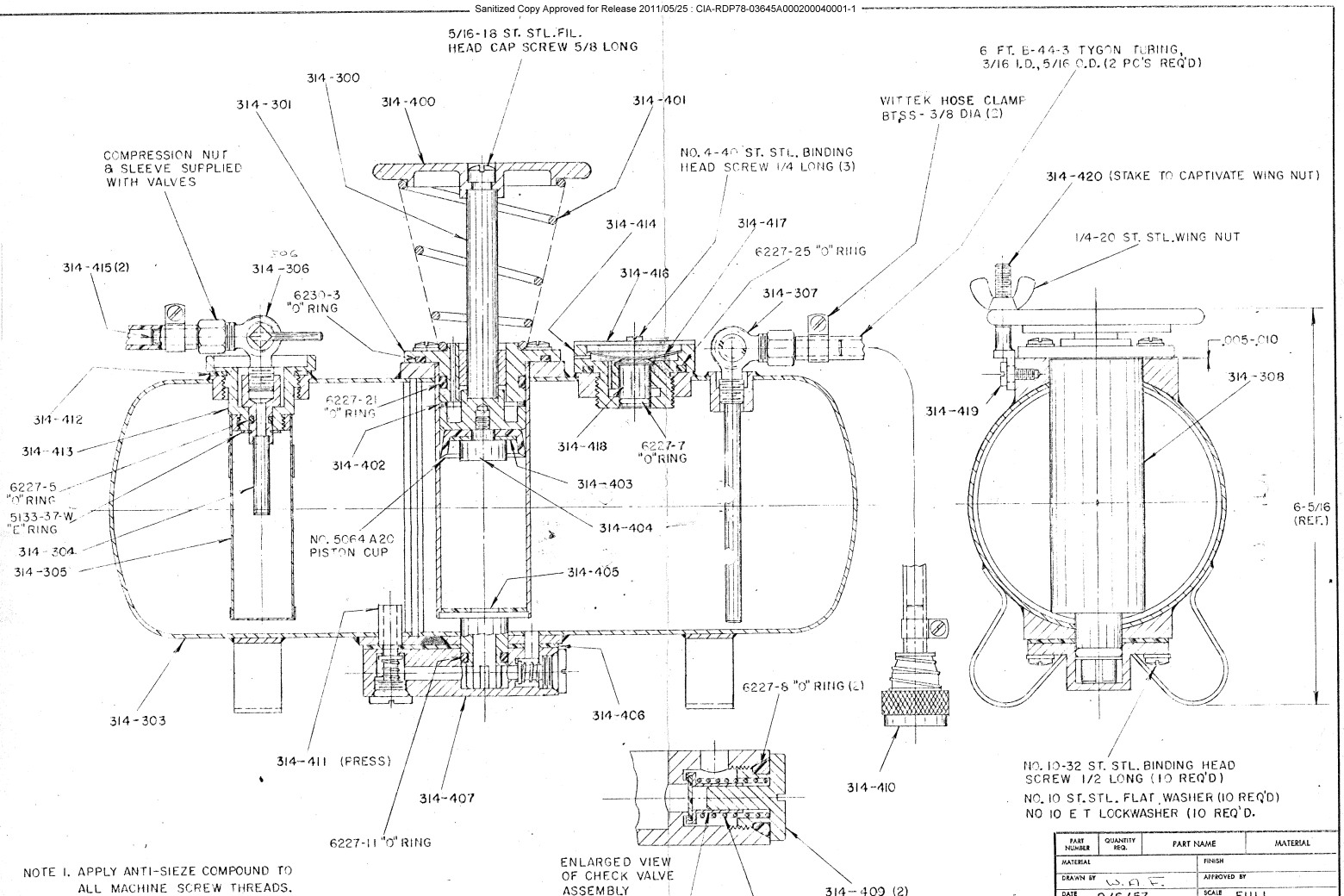
b. Tank

(1) The tank is fairly easy to disassemble (see drawing) for cleaning and this should be done periodically to avoid clogging due to particles returned with the water to the reservoir. The small valve and springs most often require this cleaning.

(2) If the valve seats become worn or otherwise give trouble they should be replaced.

c. Winch

The winch has felt seals to keep dirt, etc. out of the vital parts but if its action becomes rough it may be disassembled, cleaned, oiled and reassembled. This job should be straightforward for any mechanic or machinist.



NOTE 1. APPLY ANTI-SIEZE COMPOUND TO ALL MACHINE SCREW THREADS.

2. APPLY PIPE COMPOUND TO ALL PIPE THREADS.

3. LUBRICATE "O" RINGS WITH DOW-CORNING 4 COMPOUND.

4. MACHINE PUMP CYLINDER TO PROVIDE .005-.010 CLEARANCE AS SHOWN.

PART NUMBER	QUANTITY REQ.	PART NAME	MATERIAL
MATERIAL			FINISH
DRAWN BY	W. E. F.		APPROVED BY
DATE	9/6/57		SCALE FULL
NEXT ASSEMBLY			MODEL

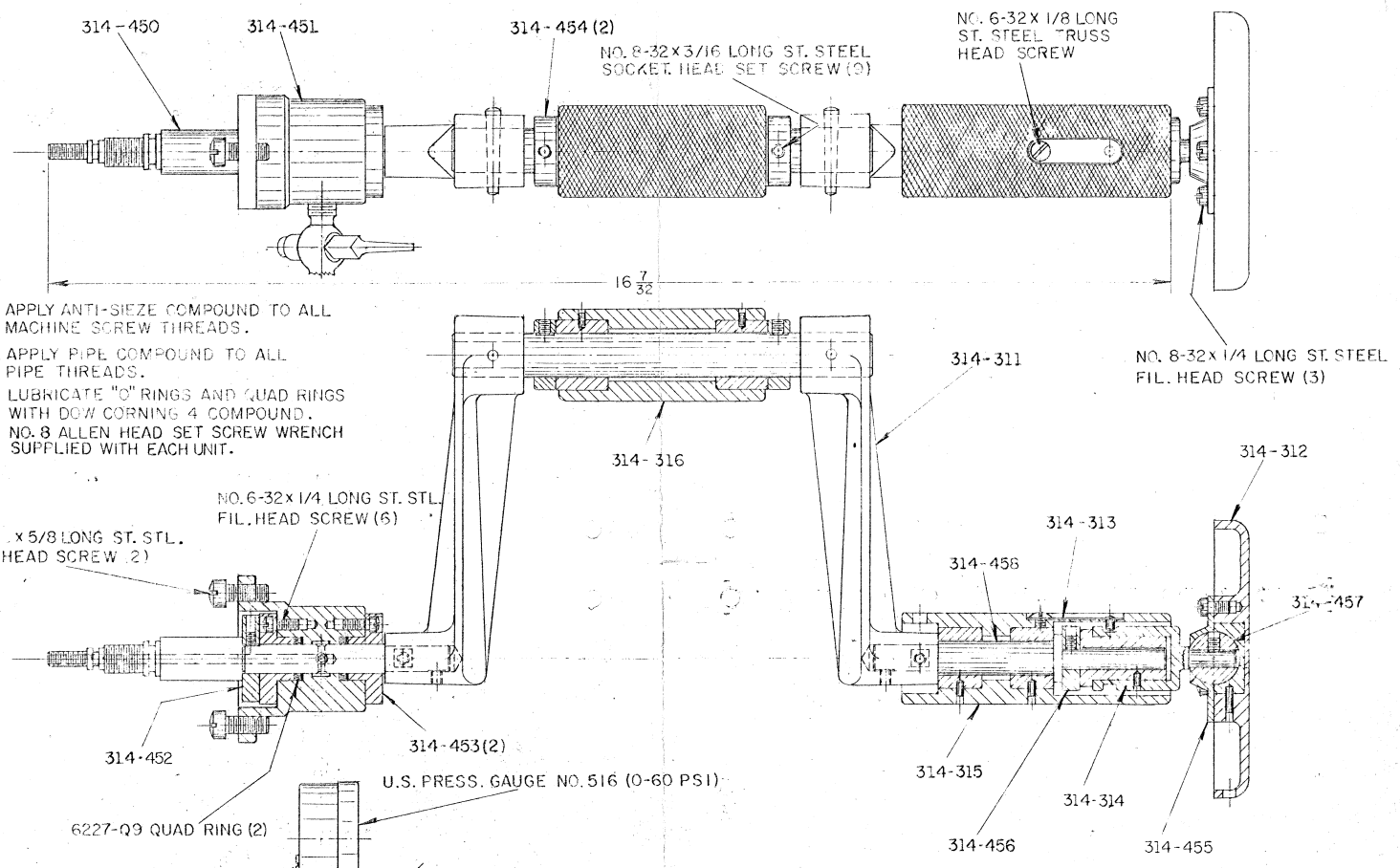
TANK ASSEMBLY

NO.	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± DECIMALS ± ANGLES ±

DWG SIZE	DWG NO.	ISSUE
C	314-200	

SHEET OF SHEETS



NOTE 1. APPLY ANTI-SIEZE COMPOUND TO ALL MACHINE SCREW THREADS.

2. APPLY PIPE COMPOUND TO ALL PIPE THREADS.

3. LUBRICATE "O" RINGS AND QUAD RINGS WITH DOW CORNING 4 COMPOUND.

4 NO. 8 ALLEN HEAD SET SCREW WRENCH SUPPLIED WITH EACH UNIT.

CONFIDENTIAL

NO.	DATE	REVISIONS	BY

UNLESS SPECIFIED ALL TOLERANCES ARE: FRACTIONS ± DECIMALS ± ANGLES ±

PART NUMBER	QUANTITY REQ.	PART NAME	MATERIAL
MATERIAL			FINISH
DRAWN BY W.A.E.			APPROVED BY
DATE 6/29/57			SCALE FULL
NEXT ASSEMBLY			MODEL

BRACE ASSEMBLY

DWG SIZE	DWG NO.	ISSUE
C	314 – 201	

SHEET OF SHEETS

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